DPP17-2017-001750

Abstract for an Invited Paper
for the DPP17 Meeting of
the American Physical Society

A near one-dimensional 2-shock indirectly driven implosion at convergence ratio ~30

STEVE MACLAREN, Lawrence Livermore National Laboratory

Inertial confinement fusion implosions at the National Ignition Facility, while successfully demonstrating self-heating due to alpha-particle deposition, have fallen short of the performance predicted by one-dimensional multi-physics implosion simulations. The current understanding, based on simulations as well as experimental evidence, suggests that the principle reason for the disagreement is a breeching of the cold fuel assembly at stagnation which would otherwise completely confine the hot spot. 3-D simulations indicate a combination of low-mode symmetry swings and ablation-front hydrodynamic instability seeded by engineering features such as the capsule tent and fill tube lead to localized thinning and perforation of the stagnated fuel, resulting in a loss of hot spot pressure and energy. We describe a short series of experiments on the NIF designed specifically to avoid these issues in order to understand if, once they are removed, a suspended-fuel-layer deuterium-tritium implosion can achieve 1-D simulated performance. The particular implosion system combines a thick capsule shell with an elevated initial ablation temperature to minimize the ablation front perturbations from the engineering features, and incorporates a large ratio of hohlraum-to-capsule radius as a means to permit a higher degree of control over implosion symmetry. The resulting implosion at a convergence ratio of ~30 was not perfectly spherically symmetric as observed by both neutron and time-resolved x-ray imaging diagnostics. However, the stagnation observables match closely the performance predicted by 1D simulations, including, when some hot spot motion is accounted for, the apparent ion temperature. We present this result along with the design for an upcoming 2-shock experiment to test whether this level of agreement with the 1D model can be achieved in the self-heating regime. This work was performed under the auspices of the Lawrence Livermore National Security, LLC, (LLNS) under Contract No. DE-AC52-07NA27344